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Canadian Atlantic Fisheries
Scientific Advisory Committee

Comité scientifique consultatif
des pêches canadiennes dans
l'Atlantique

CAFSAC Research Document 90/ 28

CSCPCA Document de recherche 90/ 28

Review of the snow crab (Chionoecetes opilio) fishery in Areas 18 and 19 (Western Cape Breton Island) for 1989.

by

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ABSTRACT

Biological characteristics of the snow crab populations fished on the western coast of Cape Breton , Areas 18 and 19, were monitored by port sampling and/or sea sampling aboard commercial vessels during the 1989 fishing seasons. Assessments of the two areas are presented based on data derived from fishermen's logbooks and processor's sales slips. Initial biomass (B_0) and exploitation level (E.L.) were estimated using Leslie analysis of catch/effort trends.

Area 19:

A total landing of 1334 t was recorded for the season. The mean CPUE decreased 24% from 58.7 kg/trap haul in 1988 to 44.5 kg/trap haul in 1989. The calculated effort increased 31% from 22794 trap hauls in 1988 to 29978 trap hauls in 1989.The mean percentage of morphometrically immature males in the catch (12%) is similar to the 1988 value.

Catch levels of over 1200 t in the past were too high to assure high catch rates of over 50 kg/trap haul that prevailed up to 1984. At the present rate of removal, a decrease in the catch rates was predicted to occur in 1989. Therefore, a catch level of around 1200 t is recommended to ensure stabilization of this fishery.

Area 18:

The catch level in 1989 (674 t) was not attained (666 t). The mean CPUE decreased from 62.0 kg/trap haul in 1988 to 58.1 kg/trap haul in 1989. The total number of trap hauls (11463) increased 6% over the 1988 value (10790).

This fishery is still highly dependent on morphometrically immature crabs (55% of the catch) which suggests that there is a waste of the resource during the fishing season. A shift of the fishing season in the spring and/or using a trap type selective towards hard mature crabs could probably protect the recruitment in that area.

RÉSUMÉ

Les charactéristiques biologiques de la pêcherie de crabe des neiges en 1989 sur la côte ouest du Cap-Breton, régions 18 et 19, ont été suivies à partir d'échantillonage des prises en mer et/ou au port. Les évaluations de la pêcherie des deux régions sont présentées basées sur les données provenant des carnets de bord des pêcheurs et des bordereaux d'achat des usines de transformation. La biomasse initiale (B_0) et taux d'exploitation (E.L.) ont été estimés en utilisant l'analyse de Leslie des fluctuations de prises/effort.

Région 19:

Des débarquements de 1334 t ont été enregistrés pour la saison. La PUE moyenne a diminué de 24% passant de 58,7 kg/casier en 1988 à 44,5 kg/casier en 1989. L'effort calculé a augmenté de 31% passant de 22794 casiers levés en 1988 à 29978 casiers levés en 1989. Le pourcentage moyen de mâles morphométriquement immatures dans les captures (12%) était semblable au niveau de 1988.

Des niveaux de capture de plus de 1200 t dans le passé ont été trop élevés pour assurer des hauts taux de capture de plus de 50 kg/casier rencontrés jusqu'en 1984. Au rythme actuel de prélèvement, une diminution des PUE était à prévoir pour 1989. Un niveau de débarquement de l'ordre de 1200 t est donc recommandé afin d'assurer la stabilisation de cette pêcherie.

Région 18:

En 1989, le niveau de capture de 674 t n'a pas été atteint (666 t). La PUE moyenne a diminué de 62,0 kg/casier en 1988 à 58,1 kg/casier en 1989. L'effort total a augmenté de 6% passant de 10790 casiers levés en 1988 à 11463 casiers levés en 1989.

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Cette pêcherie est encore hautement dépendante du crabe morphométriquement immature (55% de la prise totale), ce qui suggère qu'il y a un gaspillage de la ressource pendant la saison de pêche. Le recrutement de cette pêcherie pourrait être protégé en changeant la saison de pêche au printemps ou en utilisant un casier sélectif envers les mâles morphométriquement matures ayant une carapace dure.

INTRODUCTION

The snow crab grounds off Cape Breton Island were first commercially exploited in the mid 1960's by a group of fishermen based in Chéticamp. The New Brunswick and Québec offshore boats started to fish sporadically the same area soon after. With the increasing value of snow crabs in the late 1970's and early 1980's, the fishery gradually expanded to cover all the snow crab grounds off the western coast of the Island. In 1978, an inshore fishing area (Area 19) was established on the western coast of the Island to be used exclusively by inshore vessels of under 13.7m (45ft) in length. At the time, 14 inshore boats were licensed for the area with a maximum of 40 traps per license. An additional 13 licenses were issued in 1979 and the maximum number of traps per license was reduced to 30. Another 34 licenses were issued in 1984 at which time the maximum number of traps per license was set to 20 and the quota per boat reduced from 37,195 kg (82,000 lbs) to 22,680 kg (50,000 lbs). This change resulted in an increase of the TAC from 1004 t in 1982 to 1385 t in 1984 . Since 1979, the catches in this fishery have been regulated by a TAC derived from Leslie analysis (Ricker,1980) of fisheries data and by boat quotas (Davidson and Comeau, 1987). In 1986, the number of licenses was reduced to 59. In 1987, the quota per boat was lowered to 19,505 kg (43,000 lbs). The subsequent decrease of 14% in the TAC had been proposed by CAFSAC in order to decrease the fishing pressure and stabilize the catch rates (Davidson and Comeau, 1987). In 1988, good catch rates resulted in the implementation of an increased quota per boat to 22,680 kg (50,000 lbs) which had been in place from 1984 to 1986 for a TAC of 1338 t. The same management regime remained for 1989. A summary of information on seasons, TAC's, catches, licenses and trap limits is presented in Table 1.

Area 18 had first been exploited in 1979 by 14 inshore vessels which were given exploratory permits allowing them to fish a maximum of 30 traps per permit. These permits were upgraded to licenses the following year and 9 additional licenses were issued to explore an area further from shore. In 1981, all 23 entrants were issued licenses and allowed to fish anywhere in Area 18. Larger mobile vessels from New Brunswick and Québec fished in Area 18 from 1980 to 1982. In 1983, the mobile fleet did not participate in this fishery as their season closed before the opening date for the inshore area. In 1984, the offshore vessels were excluded from the zone and northwestern and southwestern boundaries were established (Figure 1). A boat quota of 36,288 kg (80,000 lbs) was put in place for Area 18 in 1981 and retained through 1985. The corresponding TAC of 835 t was a preliminary figure which was used for management purposes as biological estimates were not available because of the unknown level of participation in the area by the mobile vessels. Declining catch rates, high exploitation levels and low production estimates resulted in a decrease in the boat quotas to 27,216 kg (60,000) in 1986 for an overall TAC of 626 t. In 1988, four new licenses were issued for a total of 27 fishermen and the TAC was set at 674 t, which allowed boat quotas of 24,948 kg (55,000 lbs). The same management regime remained for 1989. Throughout the history of the fishery, white (soft shell) crabs have been a problem in Area 18. In 1981, an early spring season in addition to the fall season was attempted to avoid poor quality crabs. This experiment was not a success as the animals caught in the spring and early summer were soft shelled and had a low meat yield. Since 1982, the season has been set for late summer and early fall with the opening date being determined by the results of meat yield tests which are done on animals caught during pre-season sampling. Further information on catches, TAC's, seasons and licenses are presented in Table 3.

This document presents a review of biological characteristics and catch trends for areas 18 and 19 snow crab fisheries for 1989 and gives advice for the 1990 fishing season for both areas.

MATERIAL AND METHODS

Port sampling and sea sampling

In Area 19, sea sampling and port sampling data were collected during the 1989 fishing season. Sea samples were obtained in weeks 1, 3 and 6 and port sampling data were collected in weeks 2 to 5. In Area 18, sea samples were carried out in weeks 2 and 6. Weekly percentages of soft (white) shelled , morphometrically immature (Conan and Comeau, 1986) and undersize males were calculated from the sea sampling data (Tables 5 and 7, Figures 2 and 4). Weekly percentages of soft (white) shelled males and immature males were obtained from the port samples (Table 6). Weekly and overall size distributions were generated and the percentages of morphometrically mature and immature male crabs in the sea samples and port samples were plotted according to their carapace size (Figures 2 , 3 and 4).

Logbook/sales slip data

The logbook and sales slip data were acquired and compiled on computer by the Statistics and EDP Systems Division of the Department of Fisheries and Oceans. The weekly and cumulative catch statistics for use in the Leslie analysis (Ricker, 1980) and the CPUE (catch in kg for a trip/number of traps hauled during the same trip) were calculated directly from the logbook data. The calculated CPUE's were summarized into weekly intervals for both areas (Tables 8 and 9).

The sales slip data, usually more representative of the real catch (Davidson and Comeau, 1987), were not used in either area because they were not all compiled at the time of these analyses. The total catch calculated from the logbooks (1200 t in Area 19 and 557 t in Area 18) was higher than the catch reported in the sales slips (1186 t in Area 19 and no data available for Area 18).

The overall distribution of fishing effort calculated from the logbooks was plotted by sub areas of 3 min. of latitude x 3 min. of longitude for Area 19 (Figure 8) and by sub areas of 2 min. of latitude x 2 min. of longitude for Area 18, (Figure 9).

RESULTS

Area 19

Sea samples: The size distribution showed a decrease in the mean size of male crabs throughout the season from 104.7 mm carapace width (CW) in week 1 to 103.2 mm CW in week 3 and to 99.9 mm CW in week 6 which corresponded to an increase in the percentage of undersized crabs from 23.2% in week 1 to 25.6% in week 3 and 44.6% in week 6(Figure 2, Table 5). The seasonal mean size was 103.4 mm CW (Figure 2) and the mean percentage of undersized male crabs was 27.8%. The seasonal percentage of berried females in the sea samples was 98.3% (N=114). The percentage of white/soft crabs decreased from 10.7% in week 1 to 10.5% in week 3 and increased to 17.6% in week 6 (Figure 2, Table 5). The percentage of morphometrically immature males (MI-males) decreased from 13.7% in week 1 to 8.0% in week 3 and increased to 10.9% in week 6 (Figure 2, Table 5). The mean percentage of MI-males for the season was 11.6%.

Port samples: The size distribution showed an increase in the mean size of male crabs from 108.5 mm CW in week 2 to 111.1 mm CW in week 3 and then a decrease to 110.6 mm CW in week 4 and to 108.9 mm CW in week 5 (Figure 3, Table 6). The seasonal mean size was

109.8 mm CW. The percentage of soft/white crabs was negligible (Table 6). The percentage of MI-males fluctuated from 8.4% in week 2 to 5.7% in week 5 with a seasonal mean of 5.3%.

The spatial distribution pattern of the fishing effort showed some expansion of the fishery towards deeper water and towards the southern end of the zone as the season progressed (Figure 8) with effort concentrated on the southern end of the zone.

The weekly CPUE decreased from 63.7kg/trap haul in week 1 to 24.9 kg/trap haul in week 6 and then fluctuated to its lowest value of 22.7 kg/trap haul in week 9. The seasonal CPUE was 44.5 kg/trap haul. Most of the effort was laid on the first four weeks of the season (Table 8). The total effort calculated for the season was 29978 trap hauls.

The estimation of initial biomass (B_0) and exploitation level (E.L.) according to the logbook data using the Leslie analysis (Figure 6) were as follows:

$$CPUE = 71.4 - 0.04\,Kt$$
$$r = -0.99$$
$$B_0 = 1865\text{ t (1736 t - 2037 t, } p<0.05)$$
$$E.L. = Tc/B_0 = 71.5\ \%$$

Area 18

The mean carapace size of male crabs in the sea samples increased from 103.3 mm CW in week 2 to 107.1 mm CW in week 6 with a seasonal mean of 104.4 mm CW (Table 7,Figure 4) for the two weeks sampled. The percentage of undersize crabs decreased from 28.5% in week 2 to 14.1% in week 6 for a seasonal mean of 24.6%. The percentage of white/soft crabs decreased from 21.2% in week 2 to 0.5% in week 6 (Table 7, Figure 4) for a seasonal mean of 15.6%. The proportion of MI-males in the sea samples increased from 62.6% in week 2 to 65.3% in week 6 (Table 7, Figure 4). An overall seasonal percentage of 63.3% was calculated from the two samples. The fishing effort was concentrated on the northern end of the zone (Figure 9). The weekly CPUE fluctuated throughout the season with the highest value (69.4 kg/trap haul) in week 6 (Table 9) with its lowest value (22.3 kg/trap haul) during week 9. The seasonal CPUE was 58.1 kg/trap haul. The total effort calculated for the season was 11463 trap hauls.

The estimation of initial biomass (Bo) and exploitation level (E.L.) according to the logbook data using the Leslie analysis (Figure 7) were as follows:

$$CPUE = 62.3 - 0.02Kt$$
$$r = -0.29$$
$$B_0 = 2555\text{ t(915 t - -671 t, } p<0.05)$$
$$E.L. = Tc/B_0 = 26\ \%$$

DISCUSSION

Area 19

The total catch was 1186 t according to the sales slip data ,1200 t according to the logbook data and 1334 t according to the quota report. That quota report is more realistic in representing the total landings.

The Leslie analysis gave an estimated B_0 of 1865 t, 12.2% higher than the 1988 value (Table 2, Figure 6). The calculated exploitation level decreased from 80.4% in 1988 to 71.5% in 1989.

The mean CPUE which has been declining continuously since 1982, increased from 30.3 kg/trap haul in 1987 to 58.7 kg/trap haul in 1988 and decreased to 44.5 kg/trap haul in 1989 (Table 2, Figure 5). That mean CPUE for 1989 remains lower than the values present before the expansion of the fishery in 1984 (Tables 1 and 2). The total number of trap hauls (29,978) in 1989 is 31.5% higher than 1988 (22,794). The mean percentage of MI-males for the season (11.6%) is lower than the 1988 value (13.0%). The trend in the mean size of males and the proportion of undersized males from 1986 to 1989 from the sea samples are as follows:

	mean size (N)	%<95 mm
1986	101.3 (988)	33.9
1987	97.8 (1375)	40.5
1988	101.8 (1774)	28.5
1989	103.4 (1211)	27.8

The catch levels (over 1200 t) during 1984 to 1986 was too high for this fishery to maintain catch rates of over 50 kg/trap that prevailed up to 1983.

It was suggested that this Area may not be able to produce more than around 1,200 t and at the present rate of removal, a decrease in the CPUE's may occur in future years as it did between 1984 and 1987 (Chiasson et al. 1989). Therefore, a catch level of around the 1,200 t level is recommended to stabilize the fishery.

Area 18.

The total catch was 557 t according to the logbook data and 666 t according to the quota report. The quota report is more representative of the real catch and represents 99% of the TAC.

As for the 1988 fishing season (Chiasson et al. 1989), the estimation of initial biomass and exploitation level using Leslie analysis were not realistic (Figure 7). The stable catch rates throughout the season are attributed to the abnormally low fishing pressure induced by very low price of crabs paid to the fishermen.

The mean CPUE decreased for two consecutive years from 64.1 kg/trap haul in 1987 to 62.0 kg/trap haul in 1988 and to 58.1 kg/trap haul in 1989. The total number of trap hauls (11463) increased by 6% over the 1988 value (10790, Table 4).

The seasonal percentage of MI-males in the catch from the sea samples (63.3%) was higher than the 1988 value (60.1%). The proportion of commercial size MI-males represents over 50% of the sampled catch and indicates that the fishery is highly dependant on recruitment and as a consequence, a high proportion of the male population is probably not able to contribute to the reproductive potential of the stock. A high proportion of immature crabs in the catch is also an indication that the area has a potential for producing a higher biomass if the immature crabs could undergo the molt to maturity (Conan and Comeau, 1986).

Since the effort increase in 1982, the CPUE's have shown a downward trend until 1985 at which time the TAC was decreased to 626 t for the 1986 season. In 1986 and 1987, catch rates improved but decreased in 1988 and again in 1989. The fishery, which was recovering from the 1982-1985 downward trend, is experiencing a decrease in CPUE's which may be the result of the catch level increase in 1988.

Whether or not the stock is composed of a high proportion of immature crabs i.e. artifact of the sampling gear, the sampling data suggests that there is a waste of the resource during the fishing season. This waste could probably be avoided by shifting the fishing season in the spring and/or using a trap type selective towards hard mature crabs. If the area is really composed of a high proportion of immature crabs, it is probably serving as a nursery zone and should therefore be protected.

Acknowledgements

The authors would like to thank Elmer Wade who assisted with the computer data analysis and Greg Roach from the Nova Scotia Department of Fisheries for his assistance and provision of a sampler.

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Table 1: Number of participants, trap limits, seasons, TAC regulations and total catch for the Area 19, western Cape Breton Island snow crab , Chionoecetes opilio, fishery: 1978-1989.

Year	# of Licensed boats	# of traps per boat *	Season	TAC (kg/license) (t)	catch (t)
1978	14	40	May 13 - Sept. 30	-	1941
1979	27	30	June 16 - Sept. 16	1406 (52164)	1390
1980	27	30	June 15 - Sept. 15	1225 (45360)	1158
1981	27	30	July 15 - Sept. 15	1004 (37195)	913
1982	27	30	July 15 - Sept. 15	1004 (37195)	953
1983	27	30	July 15 - Sept. 15	1004 (37195)	906
1984	61	20	July 15 - Sept. 15	1385 (22680)	1315
1985	61	20	July 15 - Sept. 15	1385 (22680)	1234
1986	59	20	July 15 - Sept. 15	1338 (22680)	1235
1987	59	20	July 15 - Sept. 15	1150 (19505)	1151
1988	59	20	July 15 - Sept. 15	1338 (22680) **	1337
1989	59	20	July 15 - Sept. 16	1338 (22680)	1334

* Standard box trap 1.5m x 1.5m x1.5m x 0.6m or 1.8m x 1.8m x 1.8m x 0.6m

** Originally set at 1150 t, the TAC has increased to 1338 t during the season.

Table 2 : Trends in exploitation level, initial (B_o) and final (B_f) biomass estimates, initial ($CPUE_o$), final ($CPUE_f$) and mean (CPUE) catch per unit effort for the Area 19 snow crab, Chionoecetes opilio, fishery: 1978-1989.

Year	Exploitation level (%)	B_o (t)	B_f (t)	Estimated production *	Trap hauls **	$CPUE_o$ (kg/trap haul)	$CPUE_f$ (kg/trap haul)	CPUE (max.-min.) (kg/trap haul)
(1) 1978	64	3016	1075	-	26301	86.4	55.0	73.8 (86.4-51.8)
(1) 1979	62	2239	848	1164	20436	69.3	45.2	68.0 (75.1-45.2)
(1) 1980	60	1838	733	990	12953	112.0	52.6	89.4 (112.0-52.6)
(1) 1981	47	1690	894	957	15396	-	-	59.3
(1) 1982	44.7	2282	1329	1388	9927	114.0	45.0	96.0 (114.0-45.0)
(1) 1983	54.7	1654	748	325	11076	98.5	36.3	81.8 (98.5-32.8)
(1) 1984	67.2	2240	925	1492	26040	93.2	51.5	50.5 (93.2-33.9)
(1) 1985	34.8	3291	2057	2366	35460	47.1	26.3	34.8 (47.1-26.3)
(1) 1986	52.7	2343	1108	286	38594	49.8	22.1	32.0 (49.8-22.1)
(2) 1987	52.5	2126	1010	1018	37987	51.6	29.8	30.3 (134.8-1.7)
(3) 1988	80.4	1662	325	652	22794	101.4	13.3	58.7 (202.5-4.0)
1989	71.5	1865	531	1540	29978	63.7	22.7	44.5 (142-0)

(1) Davidson and Comeau, 1987
(2) Chiasson et al, 1988
(3) Chiasson et al, 1989

* $B_o^t - B_f^{t-1}$ where t=year
** Total catch/mean CPUE

Table 3: Number of participants, trap limits, seasons, TAC regulations and total catch for the Area 18, western Cape Breton Island snow crab, Chionoecetes opilio, fishery: 1979-1988.

Year	# of Licensed boats	# of traps per boat *	Season	TAC (kg/license) (t)	catch (t)
(1) 1979	14	30	July 1 - Sept. 30	-	213
(1) 1980	23	30 **	July 15 - Sept. 15	-	519
(1) 1981	23	30	April 15 - June 15 Sept. 1 - Nov. 30	835 (36288)	494
(1) 1982	23	30	Aug. 20 - Nov. 30	835 (36288)	824
(1) 1983	23	30	Aug. 15 - Nov. 3	835 (36288)	822
(1) 1984	23	30	Aug. 25 - Nov. 10	835 (36288)	722
(1) 1985	23	30	Aug. 3 - Oct. 31	835 (36288)	537
(1) 1986	23	30	Aug. 4-8 ; 28 - Oct. 28	626 (27216)	618
(2) 1987	23	30	Aug. 16 - Oct. 10	626 (27216)	626
(3) 1988	27	30	Aug. 26 - Oct. 26	674 (24948)	669
1989	27	30	Sept. 4 - Nov. 4	674 (24948)	666

(1) Davidson and Comeau, 1987
(2) Chiasson et al. , 1988
(3) Chiasson et al., 1989

* Standard box traps - 1.5m x 1.5m x 0.6m or 1.8m x 1.8m x 0.6m
** 9 or 10 new exploratory permit holders were allowed 20 traps.

Table 4: Trends in exploitation level, initial (B_o) and final (B_f) biomass estimates, and initial ($CPUE_o$), final ($CPUE_f$) and mean (CPUE) catch per unit effort for the Area 18 snow crab, Chionoecetes opilio, fishery: 1979-1989.

Year	Exploitation level (%)	B_o (t)	B_f (t)	Estimated production *	Trap hauls **	$CPUE_o$ (kg/trap haul)	$CPUE_f$ (kg/trap haul)	CPUE (max.-min.) (kg/trap haul)
(1) 1979	49.7	428	215.7	-	4449	37.3	30.7	47.9 (61.0-37.3)
(1) 1980	-	-	-	-	10745	61.2	47.7	48.3 (61.2-39.4)
(1) 1981	-	-	-	-	10207	-	-	48.4
(1) 1982	-	-	-	-	13290	98.0	23.0	62.0 (122.0-23.0)
(1) 1983	45.8	1577	854	-	18940	41.4	34.0	43.4 (49.9-33.8)
(1) 1984	40.1	1147	687	293	20168	41.9	27.2	35.8 (41.9-27.2)
(1) 1985	71.3	753	216	66	17102	49.1	24.1	31.4 (49.1-17.2)
(1) 1986	59.7	1153	465	937	14372	61.8	55.3	43.0 (61.8-26.6)
(2) 1987	47.4	1315	691	850	9766	64.5	26.4	64.1 (140.2-11 0)
(3) 1988	-	-	-	-	10790	64.2	69.2	62.0 (190.0-2.7)
1989	-	-	-	-	11463	70.1	22.3	58.1 (136.7-3.0)

(1) Davidson and Comeau, 1987
(2) Chiasson et al, 1988
(3) Chiasson et al, 1989

* $B_o^t - B_f^{t-1}$ where t=year
** Total catch/mean CPUE

Table 5: Biological characteristics of snow crab Chionoecetes opilio, present in the sea samples taken during the western Cape Breton Island, Area 19 snow crab fishing season 1989.

Week	Total # of observations	Mean Size (mm)	% of immature crabs (N) <95 mm	% of immature crabs (N) ≥95 mm	% of immature crabs (N) Total	% White crabs	% Undersized crabs
1- July 16-22	638	104.7	27.9 (147)	9.5 (486)	13.7 (633)	10.7	23.2
2- July 23-29	-	-	-	-	-	-	-
3- July 30-Aug. 5	351	103.2	11.2 (89)	6.9 (259)	8.0 (348)	10.5	25.6
4- Aug. 6-12	-	-	-	-	-	-	-
5- Aug. 13-19	-	-	-	-	-	-	-
6- Aug. 20-26	222	99.9	15.2 (99)	7.4 (121)	10.9 (220)	17.6	44.6
7- Aug. 27-Sept.2	-	-	-	-	-	-	-
8- Sept. 3-9	-	-	-	-	-	-	-
9- Sept. 10-16	-	-	-	-	-	-	-
Total	1211	103.4	19.7 (335)	8.4 (866)	11.6 (1201)	11.9	27.8

Table 6: Biological characteristics of snow crab *Chionoecetes opilio*, present in the port samples taken during the western Cape Breton Island, Area 19 snow crab fishing season 1989.

Week	Total # of observations	Mean Size (mm)	% of immature crabs (N)	% White crabs
1- July 16-22	-	-	-	-
2- July 23-29	204	108.5	8.4	0
3-July 30-Aug. 5	333	111.1	2.1	0
4- Aug. 6-12	239	110.6	6.4	0
5- Aug. 13-19	394	108.9	5.7	1.0
6- Aug. 20-26	-	-	-	-
7- Aug. 27-Sept. 2	-	-	-	-
8- Sept. 3-9	-	-	-	-
9- Sept. 10-16	-	-	-	-
Total	1170	109.8	5.3 (1151)	0.3

Table 7: Biological characteristics of snow crab Chionoecetes opilio, present in the sea samples taken during the western Cape Breton Island, Area 18 snow crab fishing season 1989.

Week	Total # of observations	Mean Size (mm)	% of immature crabs (N)			% White crabs		% Undersized crabs
			<95 mm	≥95 mm	Total	<95 mm	≥95 mm	
1- Sept. 3-9	-	-	-	-	-	-	-	-
2- Sept. 10-16	533	103.3	86.8 (152)	52.9 (380)	62.6 (532)	17.8	22.6	28.5
3- Sept. 17-23	-	-	-	-	-	-	-	-
4-Sept. 24-30	-	-	-	-	-	-	-	-
5- Oct. 1-7	-	-	-	-	-	-	-	-
6- Oct. 8-14	199	107.1	96.4 (28)	60.2 (171)	65.3 (199)	3.0	0.5	14.1
7- Oct. 15-21	-	-	-	-	-	-	-	-
8- Oct. 22-28	-	-	-	-	-	-	-	-
9- Oct. 29-Nov. 4	-	-	-	-	-	-	-	-
Total	732	104.4	88.3 (180)	55.2 (551)	63.3 (731)	15.6	15.6	24.6

Table 8: The 1989 western Cape Breton Island, Area 19 snow crab, Chionoecetes opilio, fishery CPUE and cumulative catch (K) statistics used in Leslie analysis.

Week	CPUE (kg/trap haul)	# Trap hauls*	Weekly logbook catch, C_{t1} (kg)	$C_{t1}/2$ (kg)	K_t (t)	% of total (C_{t1}/C_{total})
1- July 16-22	63.7	7121	473856	236928	236.9	39.50
2- July 23-29	45.6	5666	265806	132903	606.8	22.16
3- July 30-Aug. 5	39.2	5551	218168	109084	848.7	18.19
4- Aug. 6-12	31.7	4296	139101	69550	1027.4	11.60
5- Aug. 13-19	30.3	1857	58524	29262	1126.2	4.88
6- Aug. 20-26	24.9	756	19716	9858	1165.3	1.64
7- Aug. 27-Sept. 2	26.2	413	10895	5447	1180.6	0.91
8- Sept. 3-9	29.5	441	13028	6513	1192.6	1.09
9- Sept. 10-16	22.7	21	476	238	1199.3	0.04
Total	mean=44.5	26122	1199570			

* Reported in the logs

Table 9: The 1989 western Cape Breton Island, Area 18 snow crab, Chionoecetes opilio, fishery CPUE and cumulative catch (K) statistics used in Leslie analysis.

Week	CPUE (kg/trap haul)	# Trap hauls*	Weekly logbook catch, C_{t1}(kg)	$C_{t1/2}$ (kg)	K_t (t)	% of total (C_{t1}/C_{total})
1- Sept. 3-9	68.5	1671	138547	69273	69.3	25.0
2- Sept. 10-16	45.1	1934	111409	55704	194.3	20.1
3- Sept. 17-23	53.7	2094	135291	67646	317.6	24.4
4- Sept. 24-30	47.7	506	24155	12077	397.3	4.4
5- Oct. 1-7	51.0	689	43650	21825	431.2	7.9
6- Oct. 8-14	69.4	763	61420	30710	483.8	11.1
7- Oct.15-21	64.6	484	37307	18654	533.1	6.7
8- Oct. 22-28	51.9	56	2909	1454	553.2	0.5
9- Oct. 29-Nov. 4	22.3	15	334	167	554.9	0.1
Total	mean=58.1	8212	555021			

* Reported in the logs

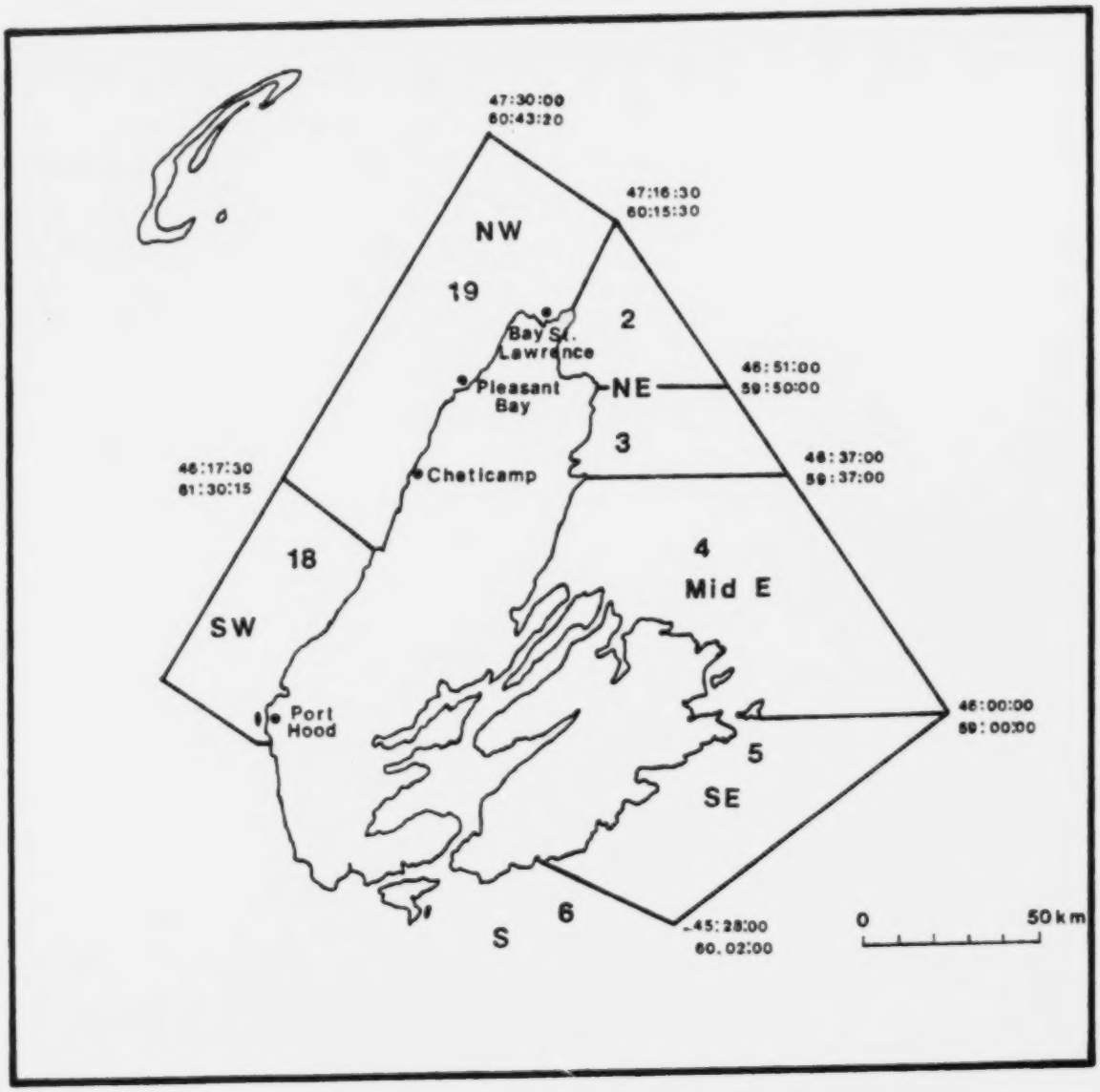


Figure 1. Cape Breton Island snow crab management areas.

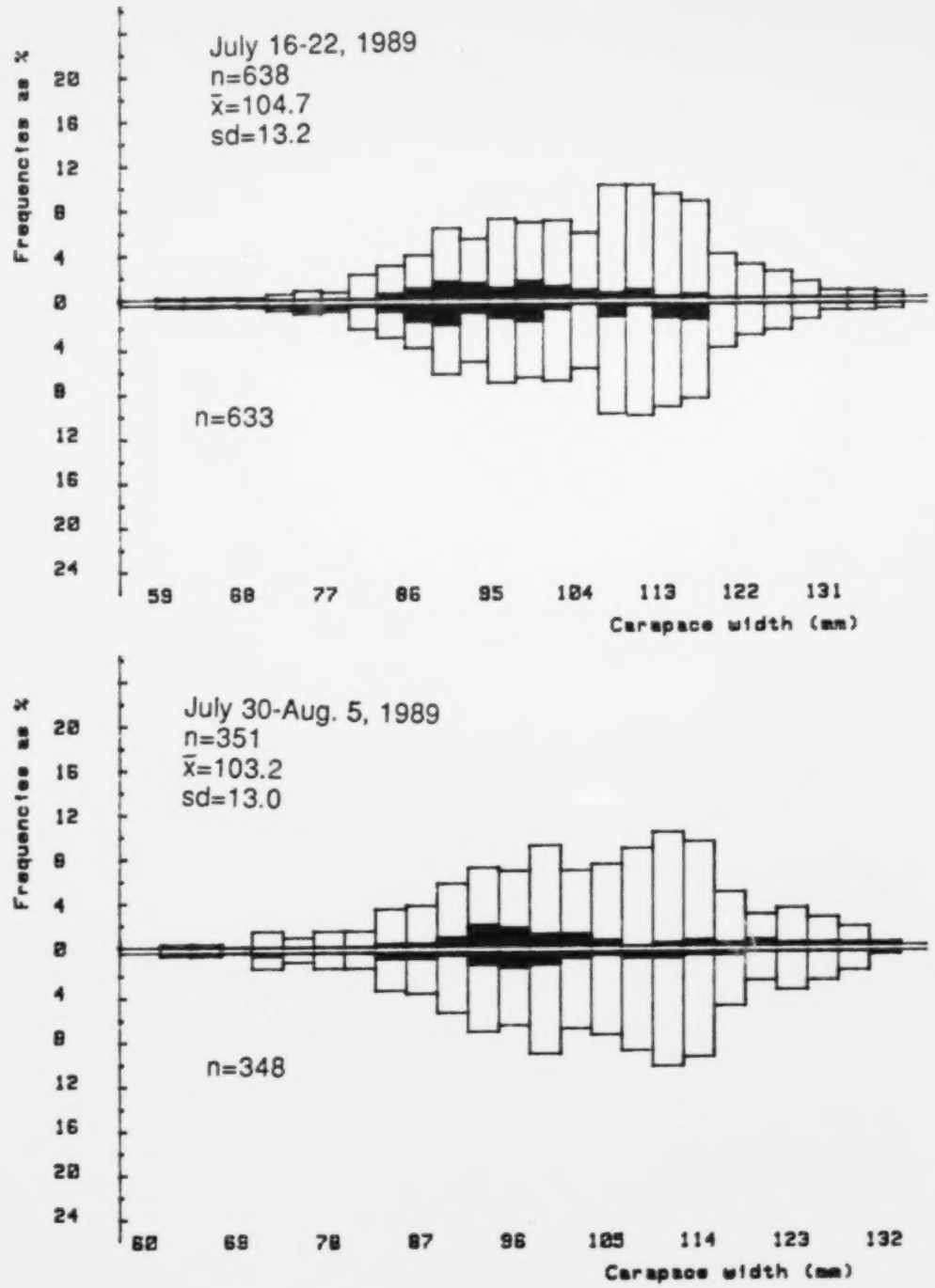
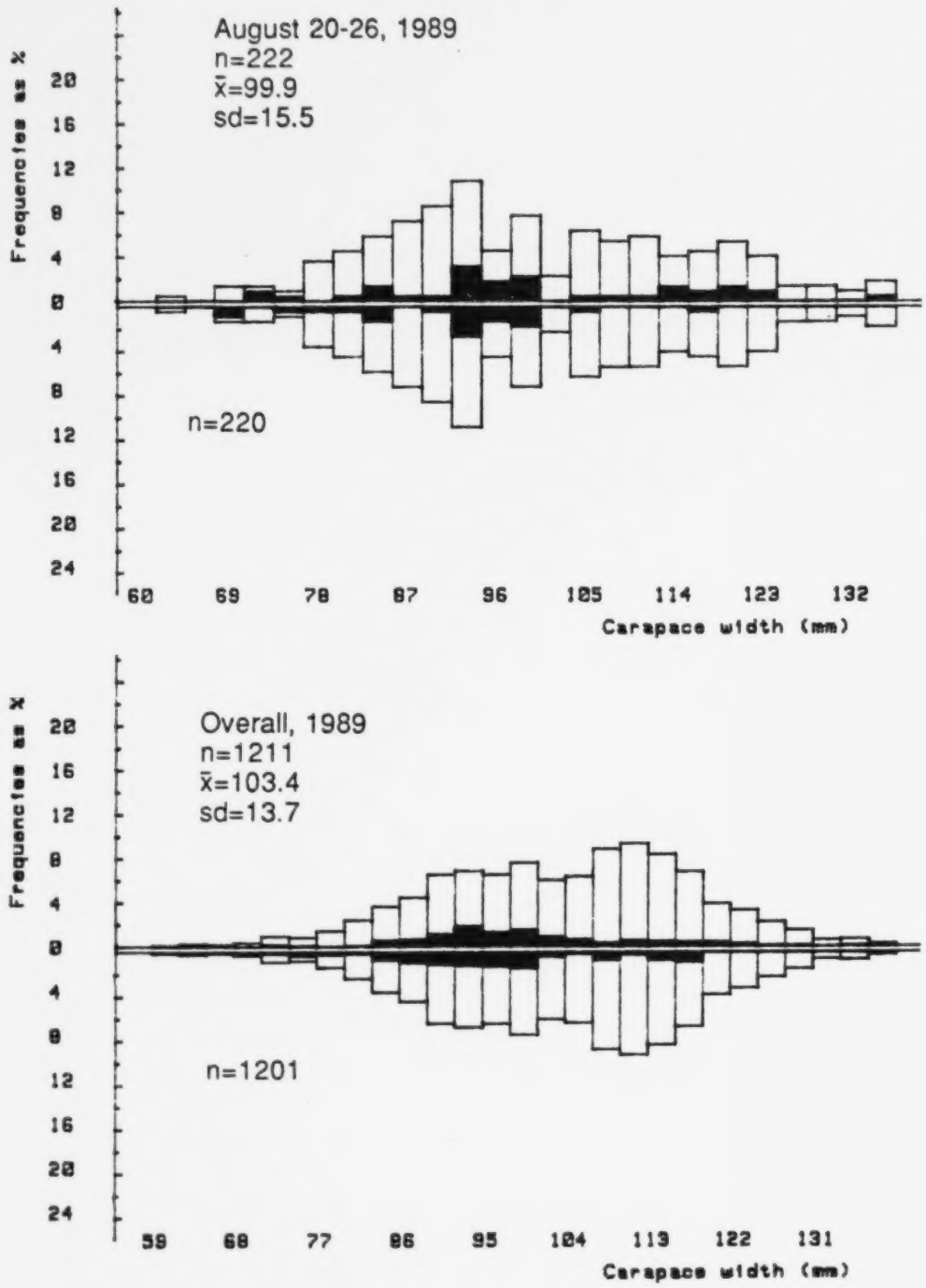


Figure 2. Weekly size distributions of male snow crabs, C. opilio, present in sea samples taken during the 1989, Area 19 Cape Breton Island snow crab fishery.
Positive field: Total number of observations (%), white/soft shelled crabs in black.
Negative field: Percentage of mature crabs in white, percentage of immature crabs in black.



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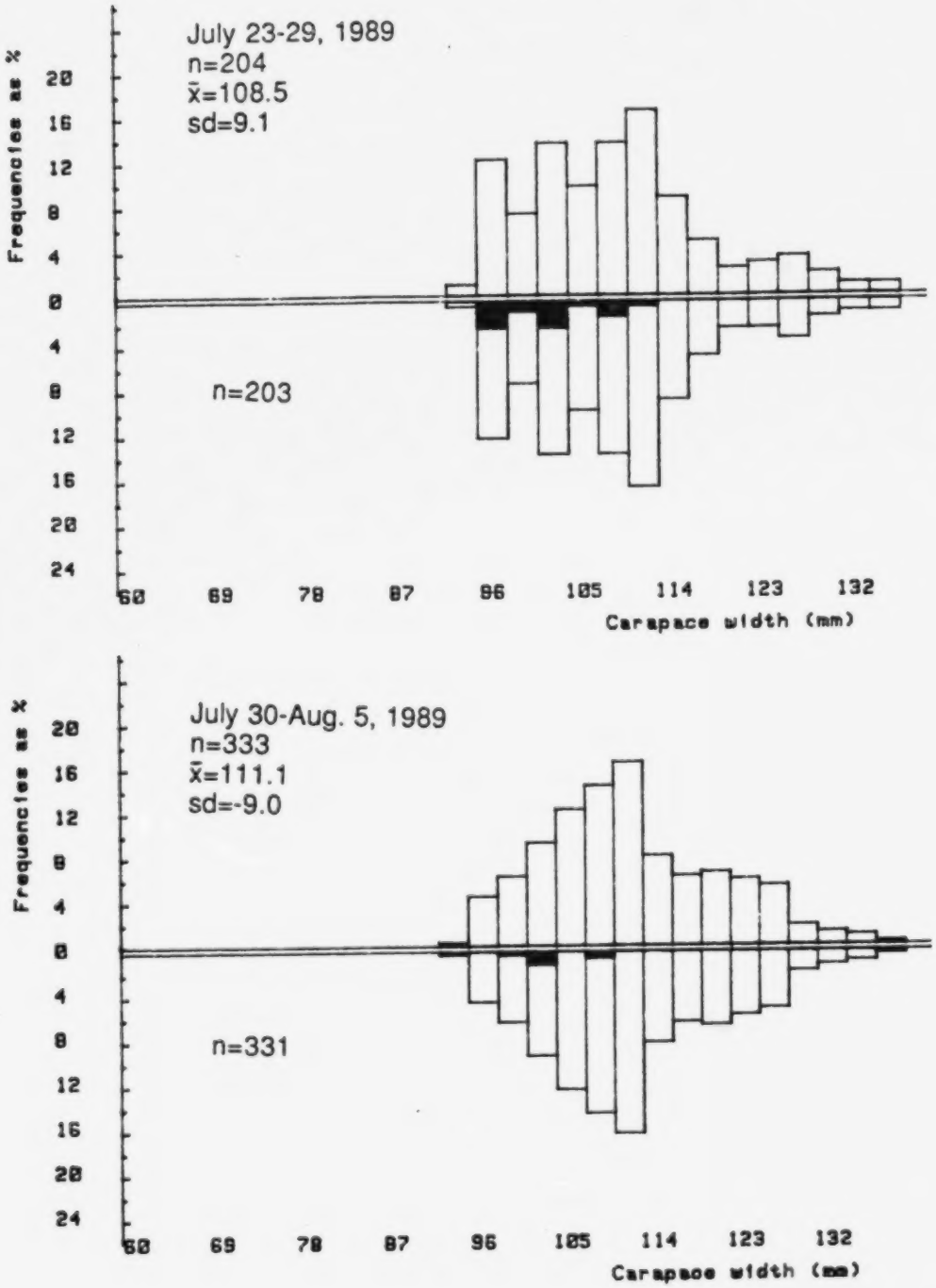
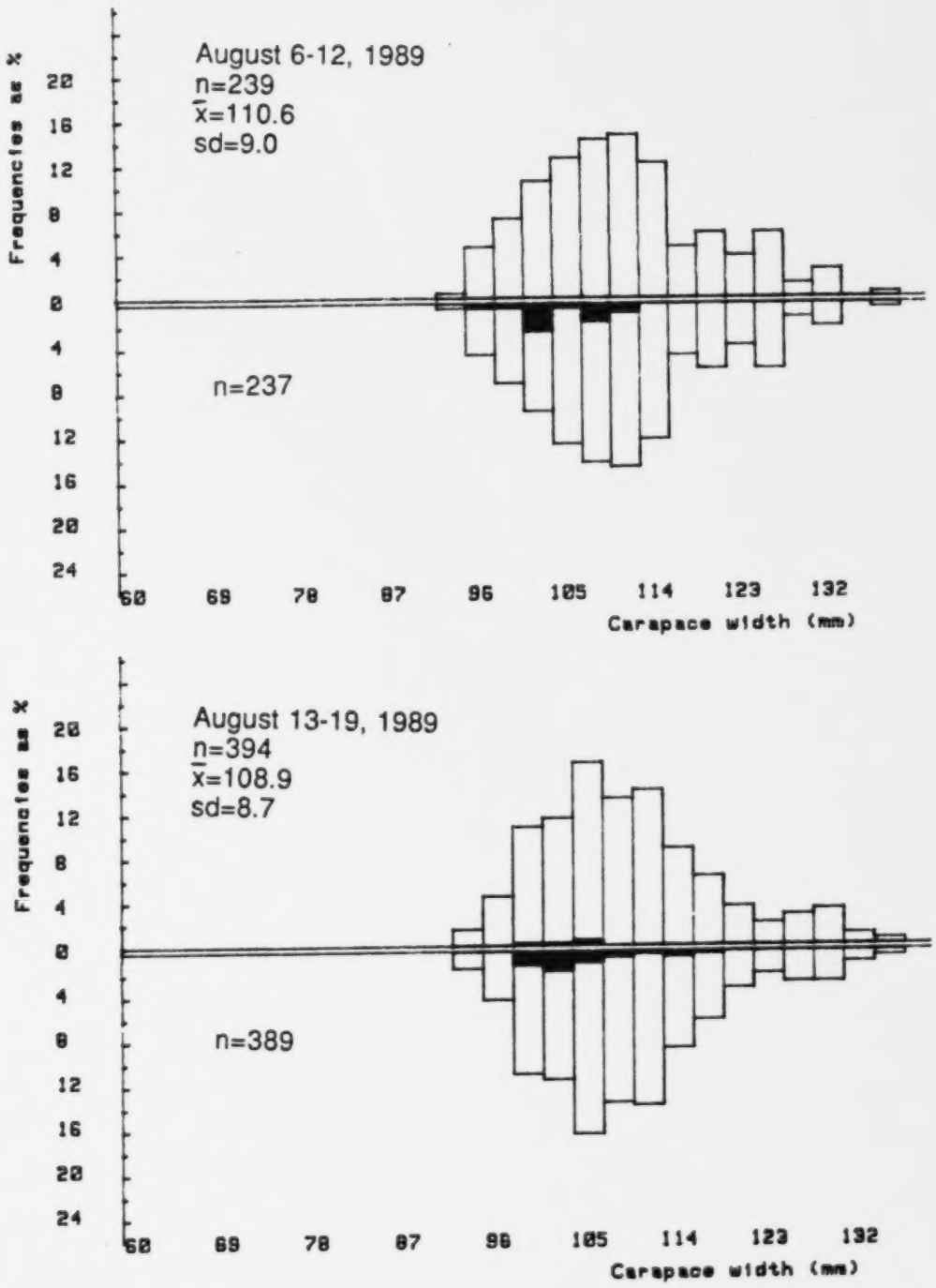


Figure 3. Weekly size distributions of male snow crabs, C. opilio, present in port samples taken during the 1989, Area 19 Cape Breton Island snow crab fishery.
Positive field: Total number of observations (%), white/soft shelled crabs in black.
Negative field: Percentage of mature crabs in white, percentage of immature crabs in black.



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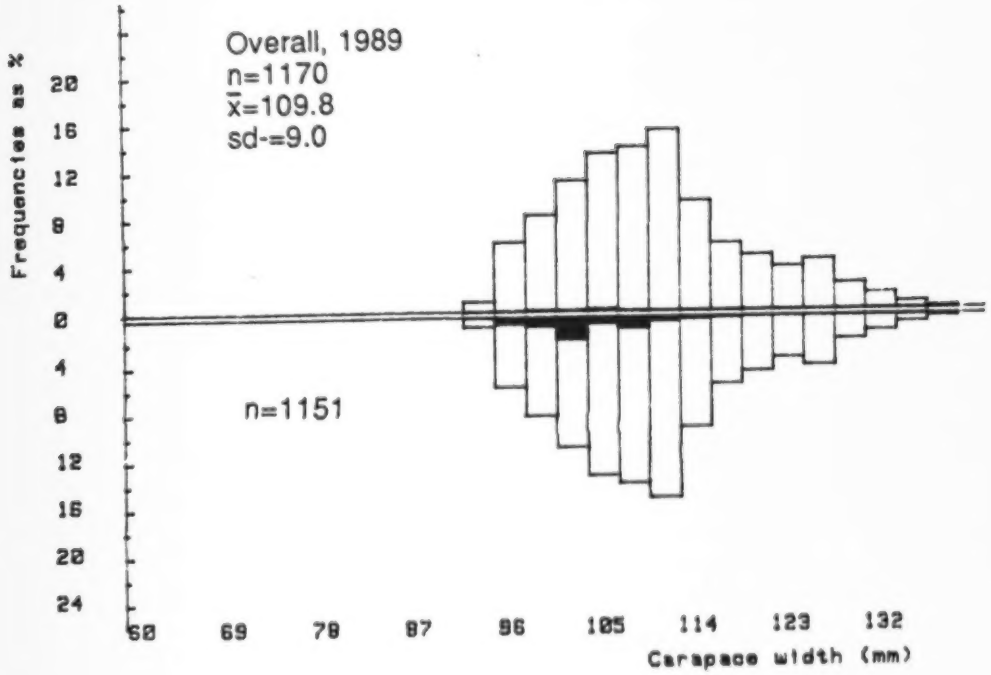

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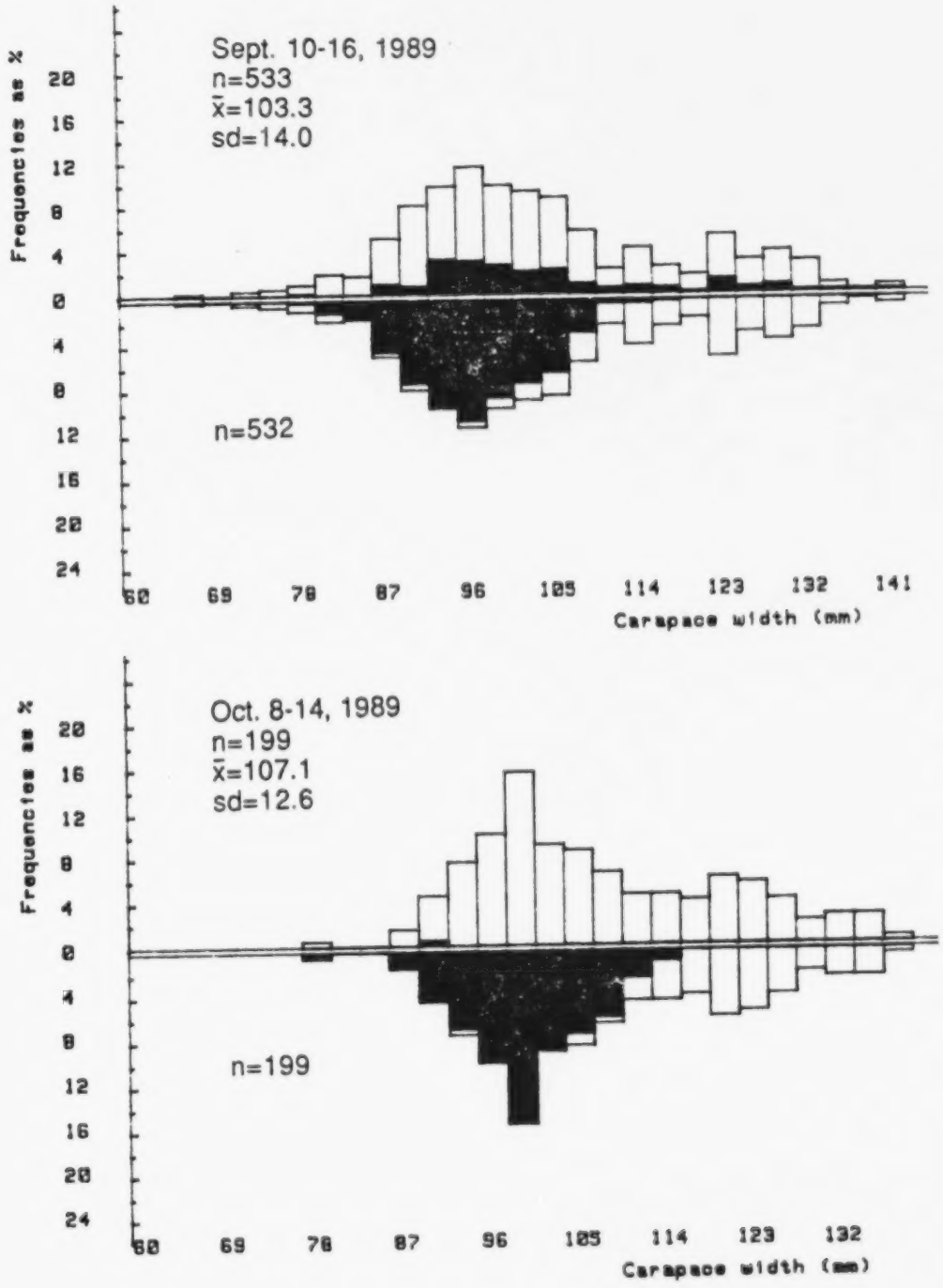
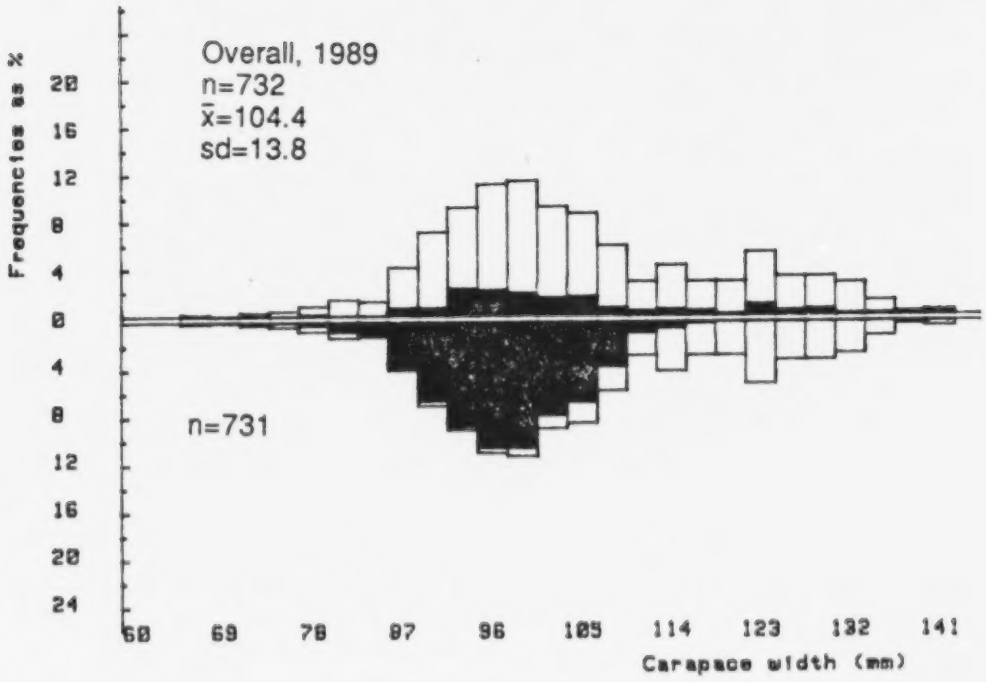


Figure 4. Weekly size distributions of male snow crabs, C. opilio, present in sea samples taken during the 1989, Area 18 Cape Breton Island snow crab fishery.
Positive field: Total number of observations (%), white/soft shelled crabs in black.
Negative field: Percentage of mature crabs in white, percentage of immature crabs in black.



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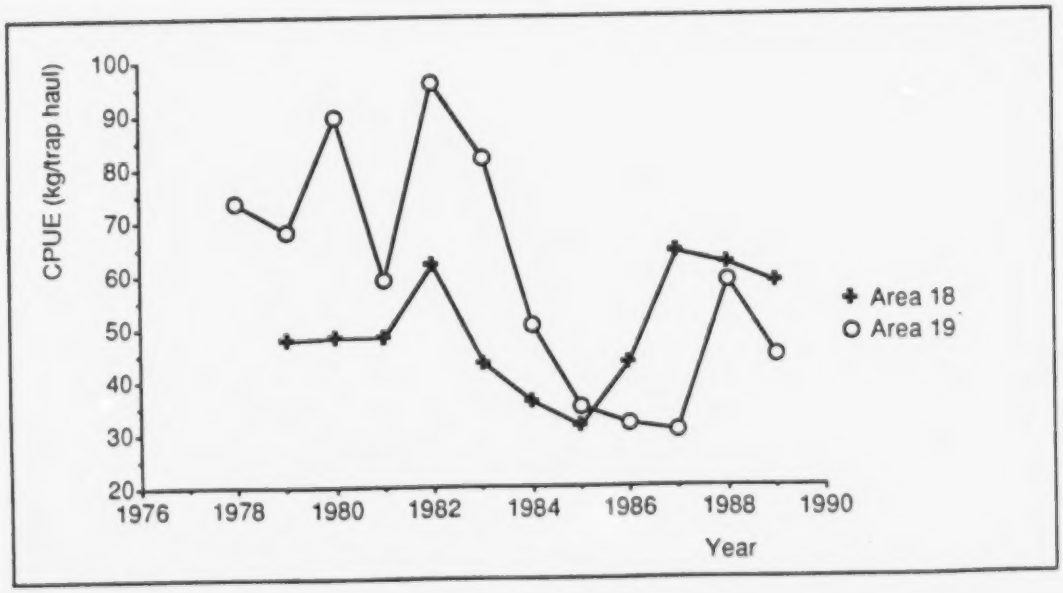


Figure 5. Trends in mean CPUE (kg/trap haul) for the snow crab, Chionoecetes opilio, fishery off Western Cape Breton Island (Areas 18 and 19) from 1978 to 1989.

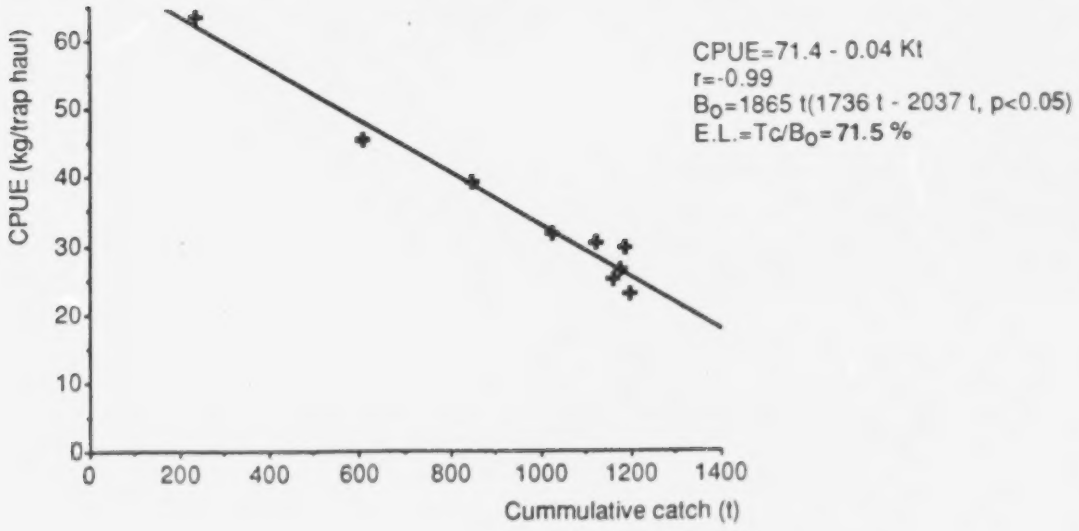


Figure 6. Cumulative logbook catch (t) versus mean weekly catch per unit effort (kg/trap haul) and Leslie analysis results for the 1989 Area 19 Cape Breton Island snow crab, Chionoecetes opilio, fishery.

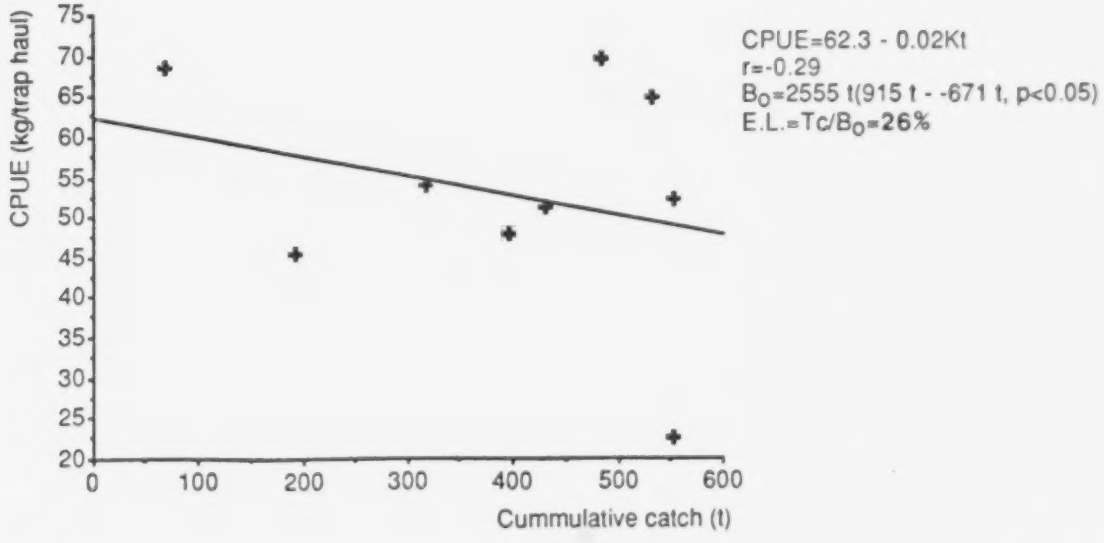


Figure 7. Cumulative logbook catch (t) versus mean weekly catch per unit effort (kg/trap haul) and Leslie analysis results for the 1989 Area 18 Cape Breton Island snow crab, Chionoecetes opilio, fishery.

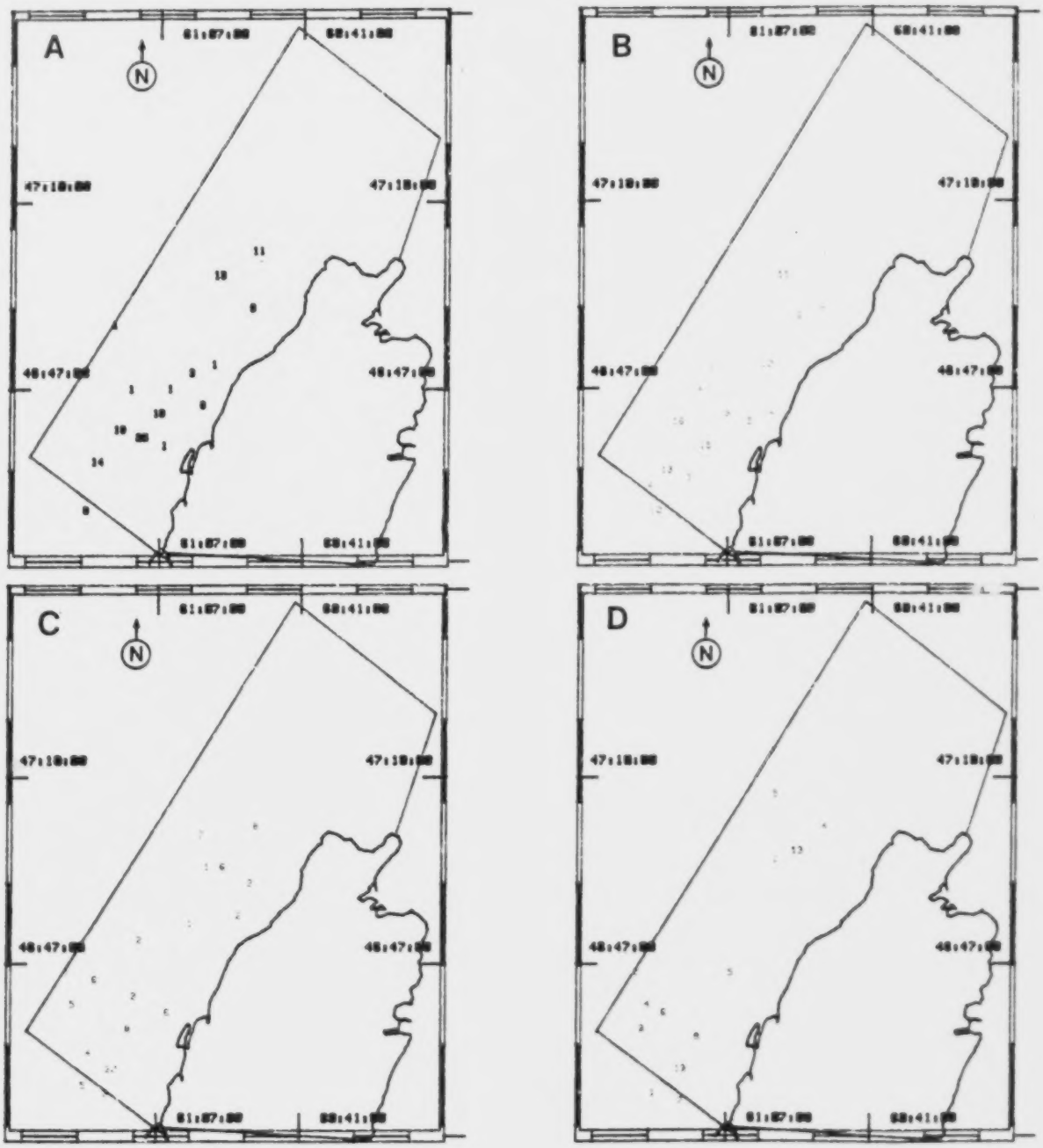
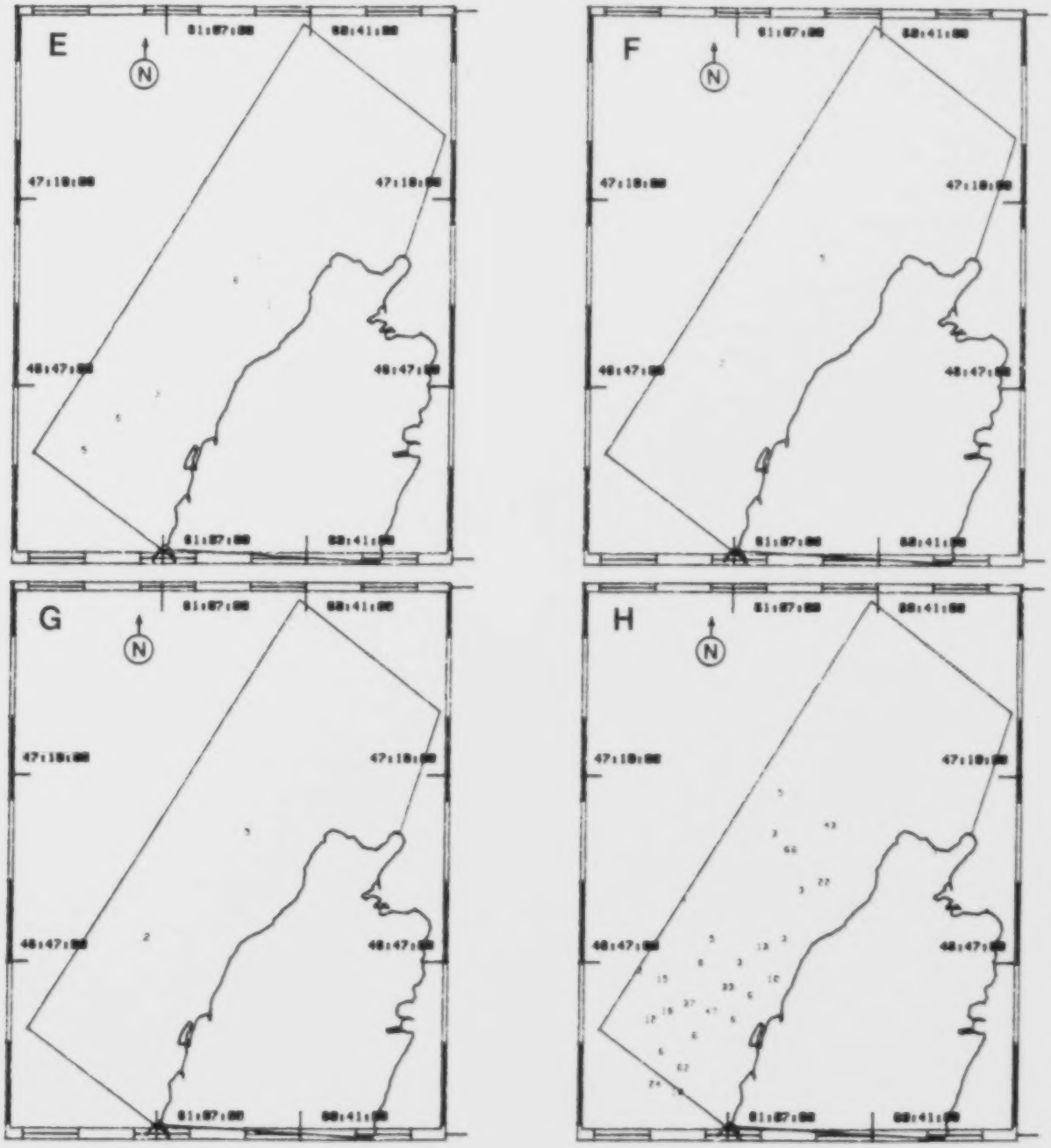


Figure 8. Distribution of fishing effort for the Area 19 Cape Breton Island snow crab, Chionoecetes opilio, fishery - 1989.
A:Week 1, B:Week 2, C:Week 3, D:Week 4, E:Week 5, F:Week 6, G:Week 7, H:Overall.
Numbers indicate number of positions reported by the fishermen.



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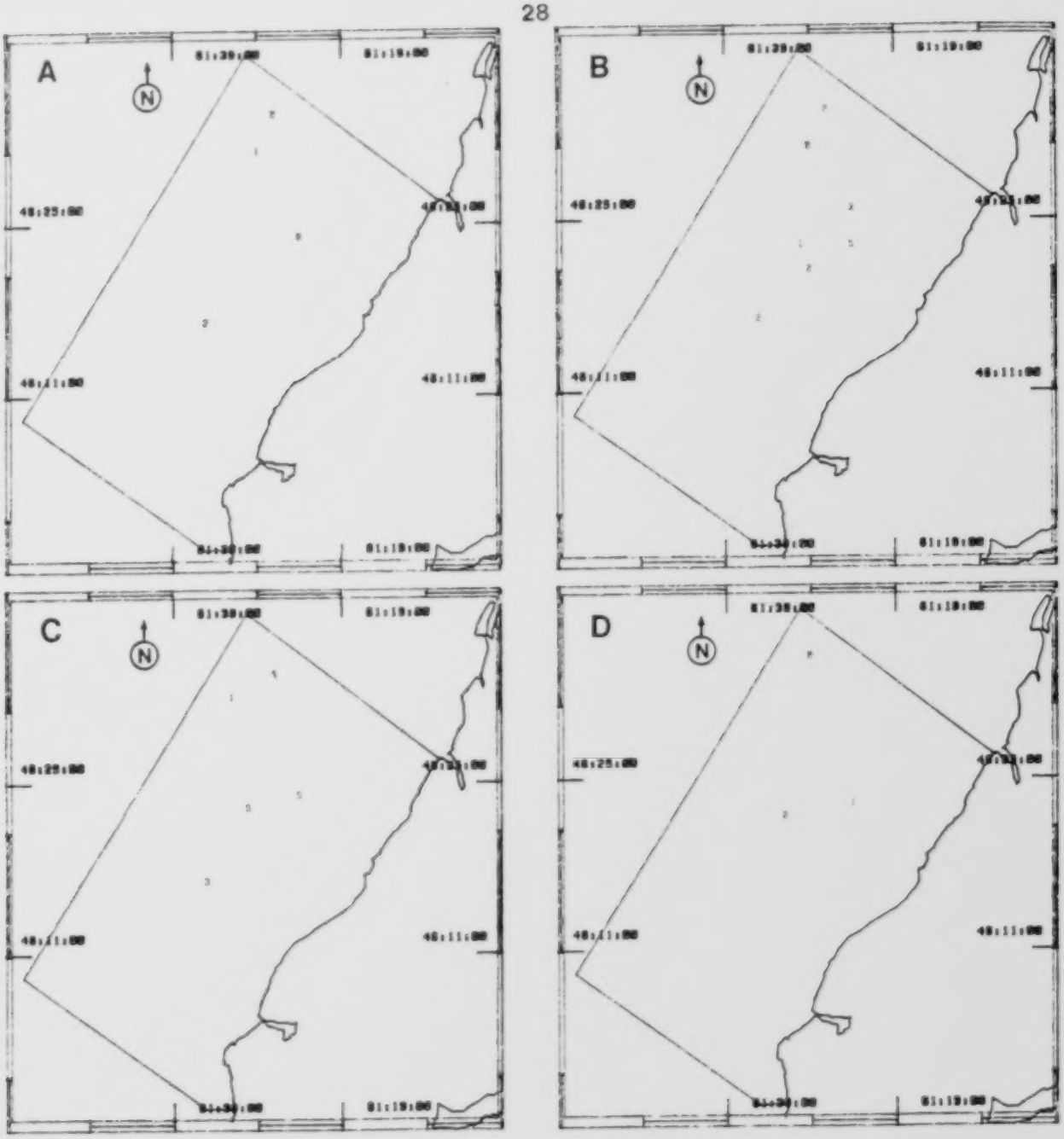
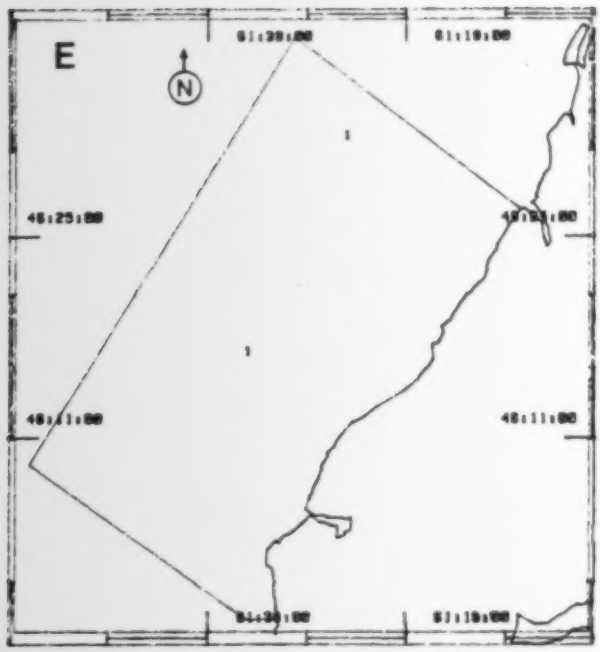
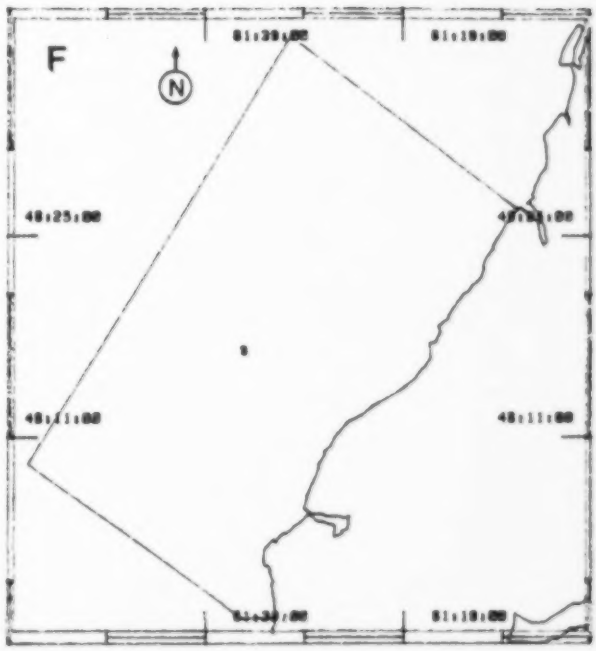


Figure 9. Distribution of fishing effort for the Area 18 Cape Breton Island snow crab, Chionoecetes opilio, fishery - 1989.
A:Week 1, B:Week 2, C:Week 3, D:Week 4, E:Week 5, F:Week 6, G:Overall.
Numbers indicate number of positions reported by the fishermen.





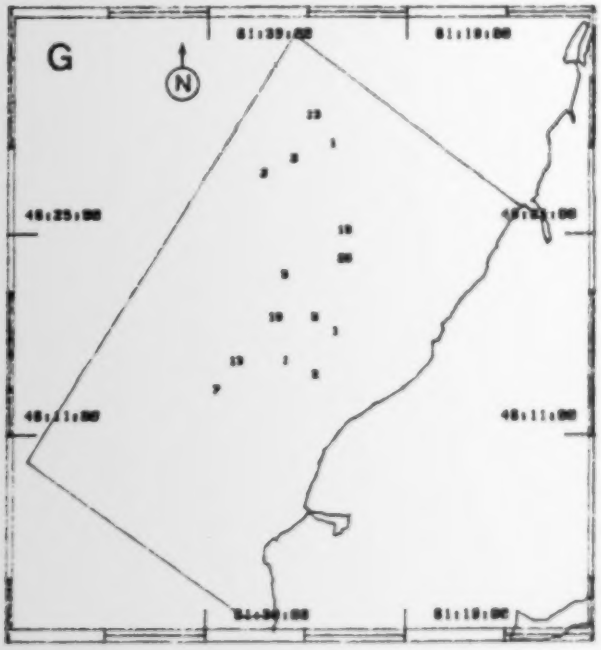


Figure 9. Cont.